

Q²
Q²
light beams from the marking or reflectance boundary portion
on the linear encoder scale and to detect a scale origin from
a difference signal between the plurality of light receiving
signals.--

REMARKS

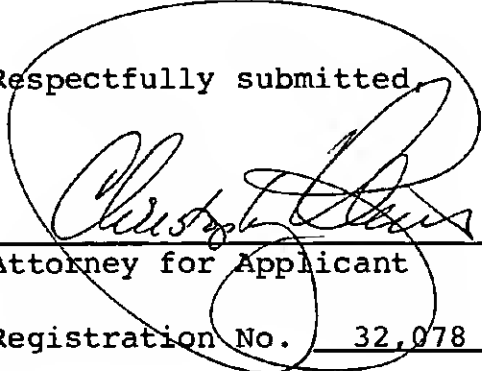
The present application is being filed concurrently
herewith.

The claims pending in the present application are
Claims 1 to 20, the independent claims being Claims 1, 7, 10
to 15 and 18 to 20. Claims 8 to 15 have been amended herein
and Claims 16 to 20 have been added to improve the form of
the claims under U.S. patent practice. No new matter has
been added.

Applicant submits that the present application is
in allowable form. Favorable consideration of the
application and early passage to issue respectfully are
requested.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,


Attorney for Applicant

Registration No. 32,078

FITZPATRICK, CELLA, HARPER & SCINTO
30 Rockefeller Plaza
New York, New York 10112-3801
Facsimile: (212) 218-2200

CPN\gmc

VERSION WITH MARKS TO SHOW CHANGES MADE TO CLAIMS

8. (Amended) An apparatus according to claim 1 [or 7], wherein said light beam splitting optical system is a crystal optical element.

9. (Amended) An apparatus according to claim 1 [or 7], wherein a boundary portion is formed on the surface of the relatively moving object to generate a reflectance difference.

10. (Amended) A magnetic recording apparatus [using said] comprising:

a displacement detection apparatus [of claim 4,]
comprising:

a light beam illuminating system for
converting a linearly polarized light beam emitted from
a light emitting element into a substantially parallel
light beam and irradiating a relatively moving object
with the light beam through a light beam splitting
optical system, said light beam splitting optical system
splitting the single parallel light beam emerging from

said light beam illuminating system into a plurality of
polarized light beams whose polarized states are
different from each other;

a focusing optical system for focusing the
plurality of split light beams to different positions on
a surface of the relatively moving object;

a polarizing prism for splitting reflected
light beams from the relatively moving object on the
basis of a difference between the plurality of
directions of polarization;

a plurality of light receiving optical systems
for individually detecting the different polarized light
beams split by said polarizing prism and outputting
light receiving signals of the respective light beams;
and

a comparator for comparing light receiving
signal levels of the respective light beams to detect a
relative displacement of the relatively moving object,

wherein a slit-shaped marking or a
three-dimensional marking is formed on the surface of

Applicant: KOH ISHIZUKA
Application No. 35.C15325
Attorney Docket No. Unassigned

the relatively moving object to generate a reflectance
difference;

a head arm having the marking or reflectance
boundary portion formed on an upper surface;

a rotary positioner having said displacement
detection apparatus on a rotary arm; and

a head arm drive motor control unit for controlling
a current of a head arm drive motor of a hard disk drive to
synchronize a motion of said rotary positioner with a motion
of said head arm so that an output from said displacement
detection apparatus becomes constant as a position of said
rotary positioner varies.

11. (Amended) A rotary encoder [using said]
comprising:

a displacement detection apparatus [of claim 4,]
comprising:

a light beam illuminating system for
converting a linearly polarized light beam emitted from
a light emitting element into a substantially parallel

Applicant: KOH ISHIZUKA
Application No. 35.C15325
Attorney Docket No. Unassigned

light beam and irradiating a relatively moving object
with the light beam through a light beam splitting
optical system, said light beam splitting optical system
splitting the single parallel light beam emerging from
said light beam illuminating system into a plurality of
polarized light beams whose polarized states are
different from each other;

a focusing optical system for focusing the
plurality of split light beams to different positions on
a surface of the relatively moving object;

a polarizing prism for splitting reflected
light beams from the relatively moving object on the
basis of a difference between the plurality of
directions of polarization;

a plurality of light receiving optical systems
for individually detecting the different polarized light
beams split by said polarizing prism and outputting
light receiving signals of the respective light beams;
and

Applicant: KOH ISHIZUKA
Application No. 35.C15325
Attorney Docket No. Unassigned

a comparator for comparing light receiving
signal levels of the respective light beams to detect a
relative displacement of the relatively moving object,
wherein a slit-shaped marking or a
three-dimensional marking is formed on the surface of
the relatively moving object to generate a reflectance
difference;

wherein the slit-shaped marking or reflectance
boundary portion is formed on a rotary disk surface; and

said displacement detection apparatus is provided
on a fixed object side to receive the plurality of reflected
light beams from the marking or reflectance boundary portion
on a moving scale and to detect a scale origin from a
difference signal between the plurality of light receiving
signals.

12. (Amended) A linear encoder [using said]
comprising:

a displacement detection apparatus of [claim 4,]
comprising:

Applicant: KOH ISHIZUKA
Application No. 35.C15325
Attorney Docket No. Unassigned

a light beam illuminating system for
converting a linearly polarized light beam emitted from
a light emitting element into a substantially parallel
light beam and irradiating a relatively moving object
with the light beam through a light beam splitting
optical system, said light beam splitting optical system
splitting the single parallel light beam emerging from
said light beam illuminating system into a plurality of
polarized light beams whose polarized states are
different from each other;

a focusing optical system for focusing the
plurality of split light beams to different positions on
a surface of the relatively moving object;

a polarizing prism for splitting reflected
light beams from the relatively moving object on the
basis of a difference between the plurality of
directions of polarization;

a plurality of light receiving optical systems
for individually detecting the different polarized light
beams split by said polarizing prism and outputting

Applicant: KOH ISHIZUKA
Application No. 35.C15325
Attorney Docket No. Unassigned

light receiving signals of the respective light beams;

and

a comparator for comparing light receiving
signal levels of the respective light beams to detect a
relative displacement of the relatively moving object,

wherein a slit-shaped marking or a
three-dimensional marking is formed on the surface of
the relatively moving object to generate a reflectance
difference;

wherein the slit-shaped marking or reflectance
boundary portion is formed on a linear encoder scale
surface[;], and

said displacement detection apparatus is provided
on a moving object side to receive the plurality of reflected
light beams from the marking or reflectance boundary portion
on the linear encoder scale and to detect a scale origin from
a difference signal between the plurality of light receiving
signals.

Applicant: KOH ISHIZUKA
Application No. 35.C15325
Attorney Docket No. Unassigned

13. (Amended) A magnetic recording apparatus

[using said] comprising:

a displacement detection apparatus [of claim 9,]

comprising:

a light beam illuminating system for
converting a linearly polarized light beam emitted from
a light emitting element into a substantially parallel
light beam and irradiating a relatively moving object
with the light beam through a light beam splitting
optical system, said light beam splitting optical system
splitting the single parallel light beam emerging from
said light beam illuminating system into a plurality of
polarized light beams whose polarized states are
different from each other;

a focusing optical system for focusing the
plurality of split light beams to different positions on
a surface of the relatively moving object;

a polarizing prism for splitting reflected
light beams from the relatively moving object on the

basis of a difference between the plurality of
directions of polarization;

a plurality of light receiving optical systems
for individually detecting the different polarized light
beams split by said polarizing prism and outputting
light receiving signals of the respective light beams;
and

a comparator for comparing light receiving
signal levels of the respective light beams to detect a
relative displacement of the relatively moving object,
wherein a boundary portion is formed on the
surface of the relatively moving object to generate a
reflectance difference;

a head arm having the marking or reflectance
boundary portion formed on an upper surface;

a rotary positioner having said displacement
detection apparatus on a rotary arm; and

a head arm drive motor control unit for controlling
a current of a head arm drive motor of a hard disk drive to
synchronize a motion of said rotary positioner with a motion

of said head arm so that an output from said displacement detection apparatus becomes constant as a position of said rotary positioner varies.

14. (Amended) A rotary encoder [using said]
comprising:
 a displacement detection apparatus [of claim 9,]
comprising:
 a light beam illuminating system for
 converting a linearly polarized light beam emitted from
 a light emitting element into a substantially parallel
 light beam and irradiating a relatively moving object
 with the light beam through a light beam splitting
 optical system, said light beam splitting optical system
 splitting the single parallel light beam emerging from
 said light beam illuminating system into a plurality of
 polarized light beams whose polarized states are
 different from each other;

Applicant: KOH ISHIZUKA
Application No. 35.C15325
Attorney Docket No. Unassigned

a focusing optical system for focusing the plurality of split light beams to different positions on a surface of the relatively moving object;

a polarizing prism for splitting reflected light beams from the relatively moving object on the basis of a difference between the plurality of directions of polarization;

a plurality of light receiving optical systems for individually detecting the different polarized light beams split by said polarizing prism and outputting light receiving signals of the respective light beams;
and

a comparator for comparing light receiving signal levels of the respective light beams to detect a relative displacement of the relatively moving object,

wherein a boundary portion is formed on the surface of the relatively moving object to generate a reflectance difference;

wherein the slit-shaped marking or reflectance boundary portion is formed on a rotary disk surface_L[;] and

Applicant: KOH ISHIZUKA
Application No. 35.C15325
Attorney Docket No. Unassigned

said displacement detection apparatus is provided
on a fixed object side to receive the plurality of reflected
light beams from the marking or reflectance boundary portion
on a moving scale and to detect a scale origin from a
difference signal between the plurality of light receiving
signals.

15. (Amended) A linear encoder [using said]
comprising:

a displacement detection apparatus [of claim 9,]
comprising:

a light beam illuminating system for
converting a linearly polarized light beam emitted from
a light emitting element into a substantially parallel
light beam and irradiating a relatively moving object
with the light beam through a light beam splitting
optical system, said light beam splitting optical system
splitting the single parallel light beam emerging from
said light beam illuminating system into a plurality of

polarized light beams whose polarized states are
different from each other;

a focusing optical system for focusing the
plurality of split light beams to different positions on
a surface of the relatively moving object;

a polarizing prism for splitting reflected
light beams from the relatively moving object on the
basis of a difference between the plurality of
directions of polarization;

a plurality of light receiving optical systems
for individually detecting the different polarized light
beams split by said polarizing prism and outputting
light receiving signals of the respective light beams;
and

a comparator for comparing light receiving
signal levels of the respective light beams to detect a
relative displacement of the relatively moving object,

wherein a boundary portion is formed on the
surface of the relatively moving object to generate a
reflectance difference;

Applicant: KOH ISHIZUKA
Application No. 35.C15325
Attorney Docket No. Unassigned

wherein the slit-shaped marking or reflectance boundary portion is formed on a linear encoder scale surface, and

said displacement detection apparatus is provided on a moving object side to receive the plurality of reflected light beams from the marking or reflectance boundary portion on the linear encoder scale and to detect a scale origin from a difference signal between the plurality of light receiving signals.